Biomass and fate of grain in harvested and unharvested agricultural fields for waterfowl in Tennessee

M.S. Proposal

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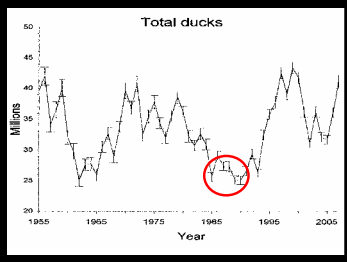
North American waterfowl populations declined to record lows in the mid-1980s.

Why?

- Long-term drought
- Pollution, urbanization
- Degradation & destruction of wetlands!

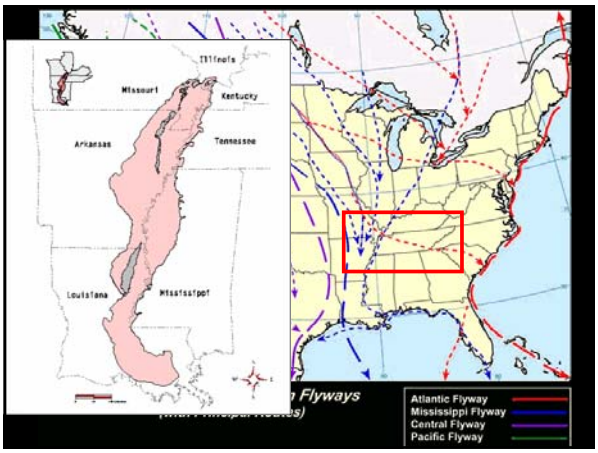


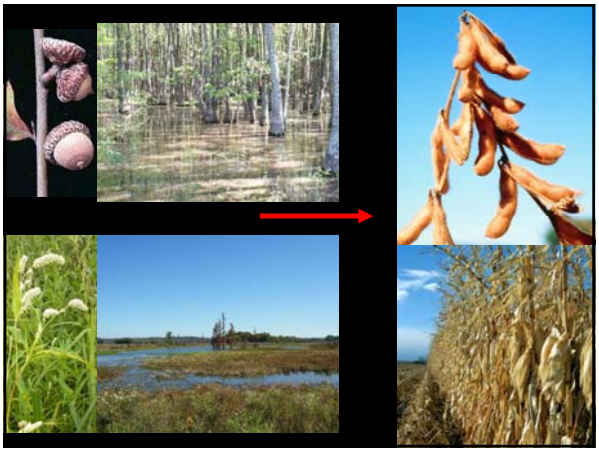
Waterfowl breeding population estimate, 1955–2007 (USFWS 2007).

1986: NAWMP created

- Joint ventures act regionally
- In non-breeding areas, focus is on providing foraging habitat
  - Rebuild lipid reserves lost in migration
  - Return north in good condition to breed

Photo: Michael Walsh





Seeds!

- 58-97% of the diets of American green-winged teal and mallards (Anderson 2000, Heitmeyer 2006).
- Waste grain: grain left in the field following harvest

Quantifying Duck Energy-Days

Prince 1979

Reinecke et al. 1989

Reinecke and Loesch 1996

$$DED = \frac{\text{Food Available (g [dry])} \times \text{TME (kcal/g [dry])}}{\text{Daily Energy Requirement (kcal/day)}}$$

Nature vs. Agriculture

Reinecke and Kaminski (2006) LMVJV estimates

	TME (kcal/g)	Biomass (kg/ha)	DEDs/ha
Corn	3.67	150	1,250
Grain Sorghum	3.49	150	1,188
Soybean	2.65	60	89
Acorns	2.76	79-166	270-1,087
Moist-soil	2.47	600	4,624 4X

Why study waste grain in the Southeast?

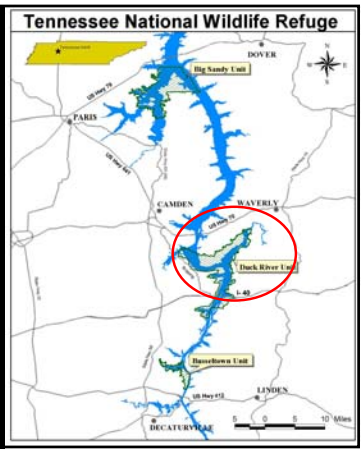
- Changes in harvest efficiency and timing
- Previous studies from geographic areas that differ greatly from SE.
- In accordance with the NAWMP, a major effort each year is to calculate DEDs.

Objectives:

1. *Estimate the biomass of agricultural seeds in harvested and unharvested corn, grain sorghum and soybean fields from harvest through January,*
2. *Quantify the amount, rate and fate of grain loss in agricultural fields from harvest to January.*
3. *Compare January biomass estimates with those currently used by the LMVJV.*
4. *Compare grain biomass and fates among four climate zones in TN.*
5. *Compare the biomass of waste grain among state, federal and privately-owned agricultural lands.*
6. *Relate microclimate conditions to rates of grain decomposition and germination.*

PLOT LOCATIONS

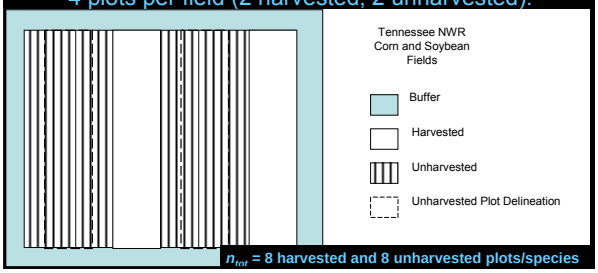
Federal land: TNWR



TNWR

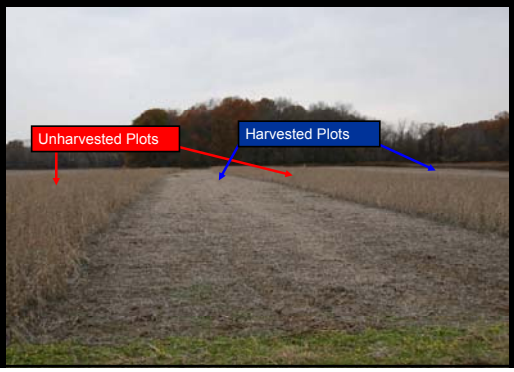
- Corn and soybean: *n* = 4 fields/species

4 plots per field (2 harvested, 2 unharvested):



n_{tot} = 8 harvested and 8 unharvested plots/species

TNWR



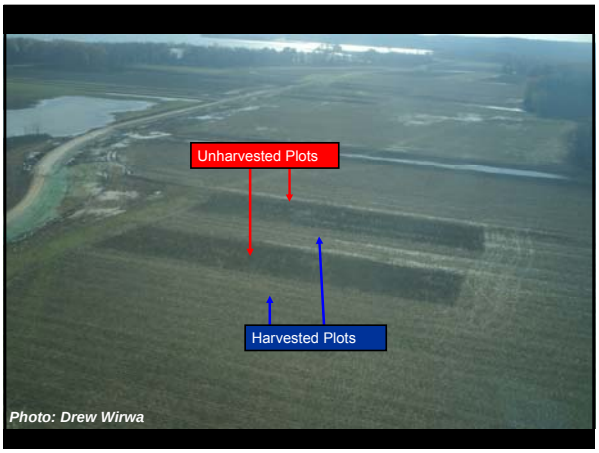


Photo: Drew Wirwa

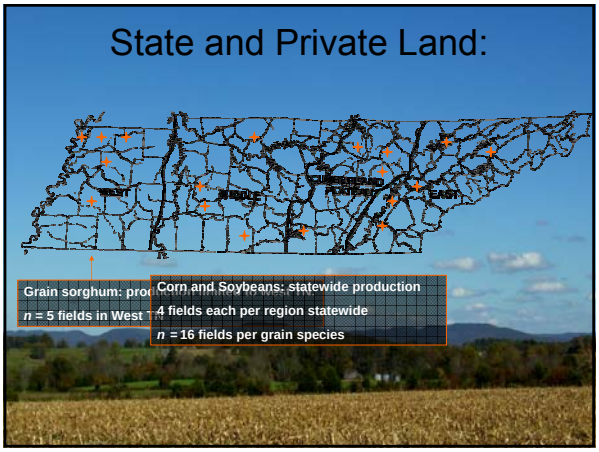
TNWR

Grain Sorghum:

n = 4 fields

None harvested

State and Private Land:



METHODS

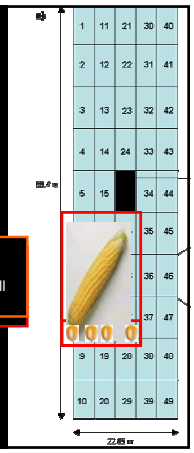
Plot Setup:

a) Fields sampled every 4 weeks post-harvest/mowdown

b) Nested design of subsampling plots (Frederick et al. 1984)

Three subsampling plots randomly selected

c) Location and design of micro-climate "fate" plot



grid overlaid for random generation of subsampling locations

Only ears of corn was sampled in harvested soybean fields and for all unharvested crops.

Searching for corn cobs…

All corn cobs with >10 kernels and sorghum seed heads >5 cm in length were collected.

Soybean subsampling plot:

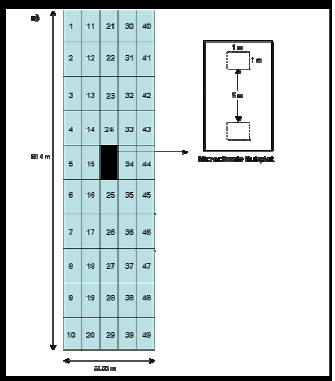
Sample Processing

1. Thresh seeds
2. Store in freezer
3. Dry to constant mass
4. Weigh

QUANTIFYING SEED FATE

Methods:

- Microclimate subplot
  - Center of exp. unit
  - Consists of open and exclosed plot.



Methods:

- 100 seeds scattered under granivore exclosure
- 100 seeds scattered in open plot 5 m away
- Counted every 4 weeks from harvest through Jan.
- Difference between exclosed and open plots = Depredation

Preliminary Results:

Analyses

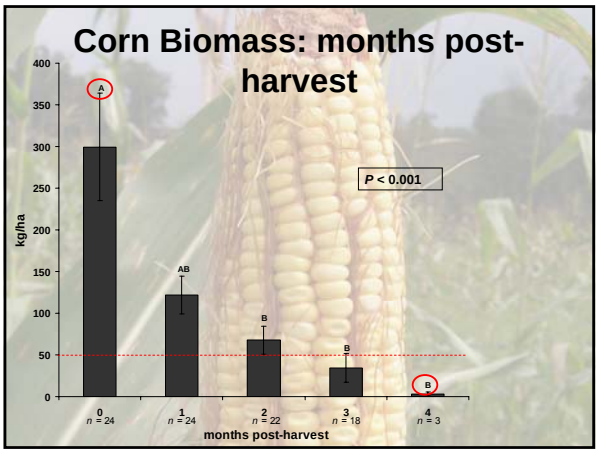
- **January biomass estimates**
  - **Means and standard errors (SE)**
  - **Qualitatively compared to estimates currently used by the LMVJV.**
- **Biomass of seed: temporal declines**
  - **Repeated-measures ANOVA**
  - **Tukey's multiple comparison test.**
- **Fate of seed in microclimate plots:**
  - **Overall percent lost to each fate**

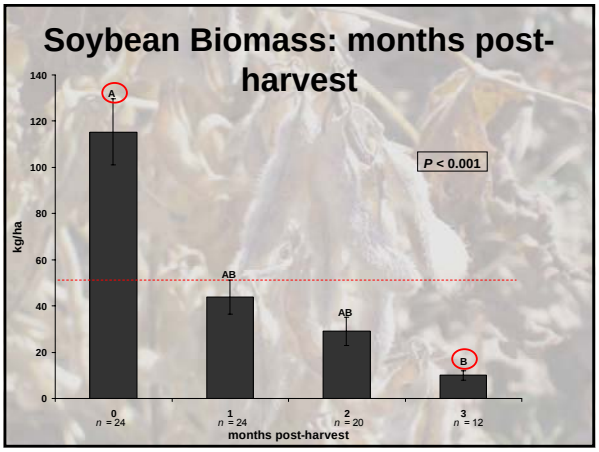
January Estimates: Harvested

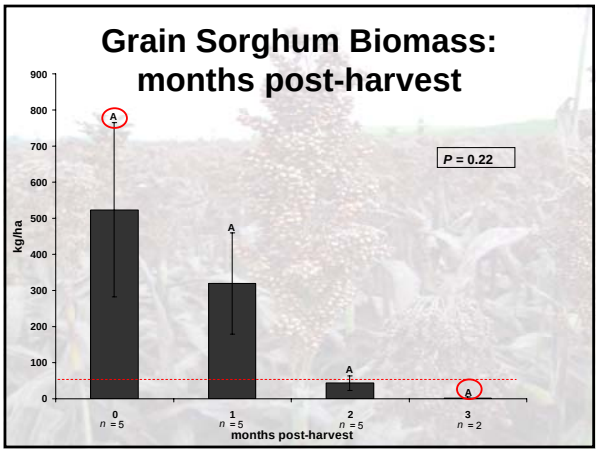
Crop	Fields (*n*)	Biomass (kg/ha) mean	Biomass (kg/ha) SE	DED/ha	LMVJV estimate (DED/ha)	
Corn	24	34.60	13.91	194.50	1,250	- 84%
Grain sorghum	5	11.22	4.31	11.88	0	Zero!
Soybean	24	16.90	4.30	19.99	89	- 78%

"Giving-up density" (Rutka 2004) = 50 kg/ha

- **DEDs functionally zero**
- **Corn and Soybean: 92% of fields below**
- **Grain Sorghum: 100% of fields below**

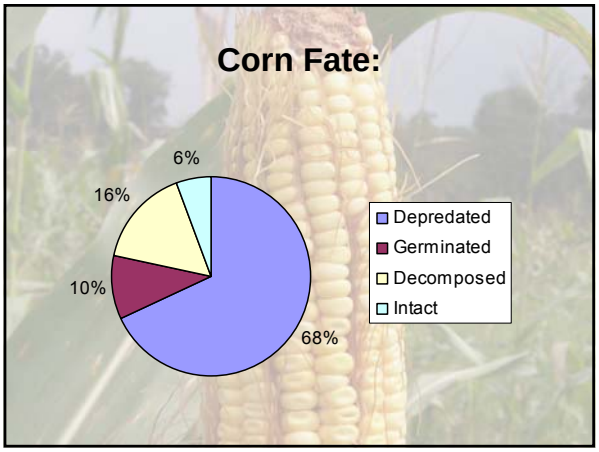

Corn Biomass: months post-harvest
P < 0.001
kg/ha
months post-harvest
A
AB
B
B
B
0 n = 24
1 n = 24
2 n = 22
3 n = 18
4 n = 3


Soybean Biomass: months post-harvest
P < 0.001
kg/ha
months post-harvest
A
AB
AB
B
0 n = 24
1 n = 24
2 n = 20
3 n = 12

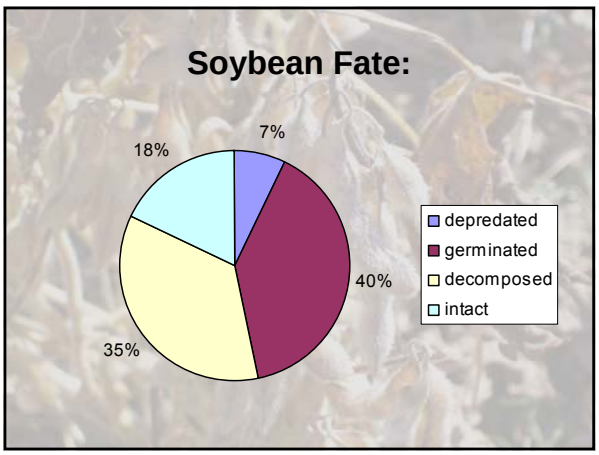

Grain Sorghum Biomass: months post-harvest
P = 0.22
kg/ha
months post-harvest
A
A
A
A
0 n = 5
1 n = 5
2 n = 5
3 n = 2

Preliminary Results: Seed Fate

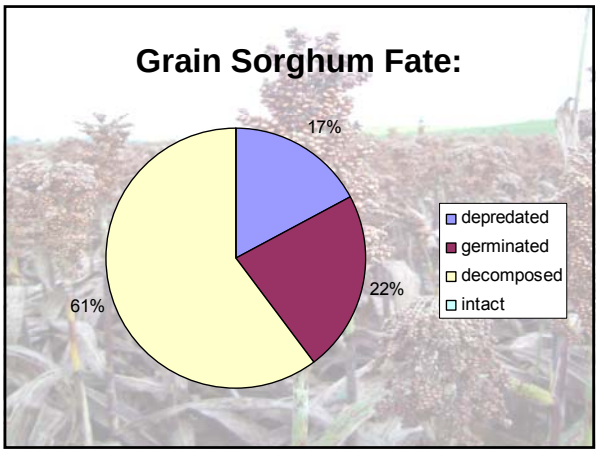
Corn Fate:



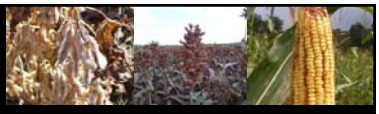
Soybean Fate:



Grain Sorghum Fate:



Note:



- Data represents individual seeds scattered on ground
  - Seed heads/cobs intact on ground
  - Seed heads/cobs on standing plants that were missed by combine

Summary:

- Corn: 194 DEDs/ha
  - 92% with 0 DEDs
  - Depredation!
- Soybean: 20 DEDs/ha
  - 92% with 0 DEDs
  - Germination and Decomposition
- Grain Sorghum: 0 DEDs/ha (100%)
  - Decomposition!

Management Recommendations:

- **Delay harvest if possible**
  - **Fields may have little nutritional value to waterfowl at 1-2 months post-harvest**
- **Plant additional food plots**
  - **Delay bush-hogging of standing crops until birds arrive**
- **Increase waterfowl carrying capacity through management of natural wetlands (e.g., moist-soil impoundments)**
  - **Decomposition of moist-soil seeds is much slower compared with agricultural seeds.**

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Questions?